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Aeronautical Electronic and Electrical Laboratory

REPORT NO. NADC-EL-6305

14 MAR 1963

PROPOSED SPECIFICATION
REGULATOR, VOLTAGE, STATIC, 28-VOLT
DIRECT CURRENT GENERATOR
GENERAL SPECIFICATION FOR

PHASE REPORT
WEPTASK NO. RAE50J011/2021/F012-11-01
Problem No. J45AE52-14

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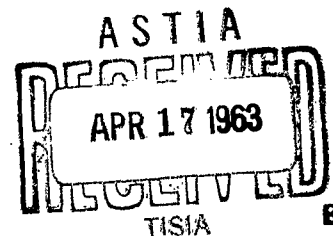
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MILITARY SPECIFICATION

REGULATOR, VOLTAGE, STATIC, 28-VOLT DIRECT CURRENT GENERATOR; GENERAL SPECIFICATION FOR

This specification has been approved by the
Bureau of Naval Weapons, Department of the Navy.

1. SCOPE

1.1 Scope - This specification covers static, 28-volt direct current voltage regulators for use to control naval aircraft direct current generators.

2. APPLICABLE DOCUMENTS

2.1 General - The following documents of the issue in effect on the date of invitation for bids form a part of this specification:

SPECIFICATIONS

Federal

QQ-P-416 Plating, Cadmium (Electrodeposited)

Military

MIL-P-116 Preservation, Methods of
MIL-M-3171 Magnesium Alloy; Processes for Corrosion Protection of
MIL-E-5272 Environmental Testing, Aeronautical and Associated Equipment, General Specification for
MIL-C-5541 Chemical films for Aluminum and Aluminum Alloys
MIL-G-6162 Generators, 30 Volt, Direct Current, Aircraft Engine Driven, General Specification for
MIL-I-6181 Interference, Controlled Requirements, Aircraft Equipment
MIL-P-6906 Plates, Information and Identification
MIL-S-7742 Screw Threads, Standard, Optimum Selected Series; General Specification for
MIL-M-7911 Marking, Identification of Aeronautical Equipment, Assemblies and Parts
MIL-P-7936 Parts and Equipment, Aeronautical Preparation for Delivery
MIL-A-8625 Anodic-Coatings, for Aluminum and Aluminum Alloys
MIL-D-70327 Drawings, Engineering and Associated Lists

STANDARDS

Military

MIL-STD-129 Marking for Shipment and Storage

MIL-STD-704 Electric Power, Aircraft, Characteristics and Utilization of

MS-33586 Metals, Definition of Dissimilar

PUBLICATIONS

Air Force-Navy Aeronautical Bulletin

ANA-143 Specifications and Standards; Use of

2.2 Availability of Documents

- (1) When requesting specifications, standards, drawings, and publications refer to both title and number. Copies of this specification and applicable specifications required by contractors in connection with specific procurement functions may be obtained upon application to the Commanding Officer, Naval Supply Depot, Code CDS, 5801 Tabor Avenue, Philadelphia 20, Pennsylvania.

3. REQUIREMENTS

3.1 Materials, Parts and Processes - Materials, parts, and processes shall be selected from the designated standards (Group I of ANA-143). When there is no suitable standard provided, it shall be the duty of the contractor to use other established specifications, drawings and publications in the order of precedence set forth in ANA-143. This use of government approved contractor's specifications shall not constitute waiver of government inspection.

3.2 Use of Standard and Nonstandard Parts - Standard parts shall be used wherever they are suitable for the fulfillment of design objectives and shall be identified on drawings by their standard part number. Standard parts shall not be used beyond the limits specified in the detail specification for the component. Commercial utility parts such as screws, bolts, nuts and cotter pins may be used provided they possess suitable properties and are replaceable by the standard parts without alteration. The corresponding standard part numbers shall be referenced in the parts list and, if practical, on the contractor's drawings. In the event there is no suitable corresponding standard part in effect on the date of invitation for bids, commercial parts may be used provided they conform to all the requirements of this specification, and are approved, in writing, by the procuring activity.

3.3 Replacement Requirement for Nonstandard Parts (Except Utility Parts) - Whenever the procuring activity permits a contractor to use items not in accordance with standard specifications because of the unavailability of standard items, the contractor shall arrange the equipment to permit replacement in the field of the nonstandard by the standard items. Mounting space and mounting holes shall be provided for the standard item and such other provisions shall be made as may be necessary.

3.4 Corrosion Resistance - Materials shall be of a corrosion resistant type or suitably processed to resist corrosion.

3.5 Dissimilar Metals - Dissimilar metals, as defined by Standard MS33586, shall not be used in contact with each other. Where such contact is unavoidable, the metals shall be protected against electrolytic corrosion. When protection is used, it shall be of such a type that a low impedance path is offered to radio frequency currents.

3.6 Nonmetals - Nonmetals used including plastics, fabrics, and protective finishes shall be moisture resistant, and shall not support fungus growth. The nonmetals shall not support combustion, and shall not be adversely affected by weather, aircraft fluids, temperatures, and ambient conditions encountered during operation of the aircraft. Nonmetals may be treated to conform to this requirement.

3.7 Flammable Materials - Materials which will ignite or explode and continue to support combustion upon removal of the ignition source shall not be used.

3.8 Design and Construction - The voltage regulator shall conform to the requirements specified on the applicable MS regulator drawing and this specification.

3.8.1 Simplification - Simplicity of design resulting from the use of the same parts for as many applications as possible in a given regulator and in regulators of different types is highly desirable.

3.8.2 Voltage Setting - The voltage regulator shall be designed and constructed to permit the regulated voltage to be set to any value between 26.0 and 30.0 volts in increments of not more than 0.05 volt. A suitable means for setting the value of the regulated voltage shall be provided. The voltage setting adjustment shall be accessible from the top of the regulator. The setting means shall be so designed and constructed that it will not be displaced by vibration or shock under any of the test conditions. A manual knob is desirable but the use of a straight screwdriver will be permitted.

3.8.3 Parallel Setting - The voltage regulator shall be designed and constructed to permit adjustment of the regulators for parallel operation. An external means shall be provided for adjustment of the regulators.

3.8.4 Effective Resistance - The regulator shall be designed with a control element giving an effective variable resistance as specified on the applicable drawing for control of the generator field current. The control element shall be a semiconductor device.

3.8.5 Equalizer Circuit - The regulator shall be provided with an equalizer circuit for obtaining equal division of the load carried by two or more generators operated in parallel. The effect of the equalizer circuit shall be determined when:

- (1) The regulator is controlling a generator in accordance with Specification No. MIL-G-6162 at minimum rated generator speed with full load on the generator.
- (2) Two regulators are controlling two generators in parallel over the applicable speed range of the generators, viz., 3,000 to 8,000 rpm.

3.8.5.1 The operation of the equalizer circuit shall not be affected by the substitution of a jumper wire from the L+ to the G+ terminals of the regulator instead of a separate G+ connection to the generator as shown on figure 1.

3.8.6 Electrical Connections - The electrical connections of the voltage regulator shall be as shown on figure 1.

3.8.6.1 The regulator shall be constructed so that a single regulator can control a single generator with only the L+, L-, and F+ terminals connected to the generator and a jumper wire placed between the L+ and G+ terminals of the regulator. No connection shall be required to any other regulator terminal for this condition of operation.

3.8.7 Maintenance - The voltage regulator shall be so designed that the life of the regulator shall be a minimum of 1,000 hours.

3.8.8 Interchangeability - All parts having the same manufacturer's part number shall be directly and completely interchangeable with each other with respect to installation and performance. Changes in manufacturer's part numbers shall be governed by the drawing number requirements of Specification No. MIL-D-70327.

3.8.9 Screw Threads - Screw threads shall conform to the requirements of Specification No. MIL-S-7742.

3.8.10 Dielectric Strength - Dielectric strength tests shall be conducted on components and sub-assemblies before final assembly.

3.8.10.1 Circuits - Circuits which operate at voltages no greater than 50 volts shall be tested at 500 volts (rms), 60 cycles for 1 minute or 600 volts (rms), 60 cycles for 1 second.

3.8.10.2 Capacitors - Capacitors shall be tested at a voltage equal to twice the voltage and at the pulse repetition rate expected to be encountered in the intended application, for a period of one minute. (See paragraph 6.2.1.)

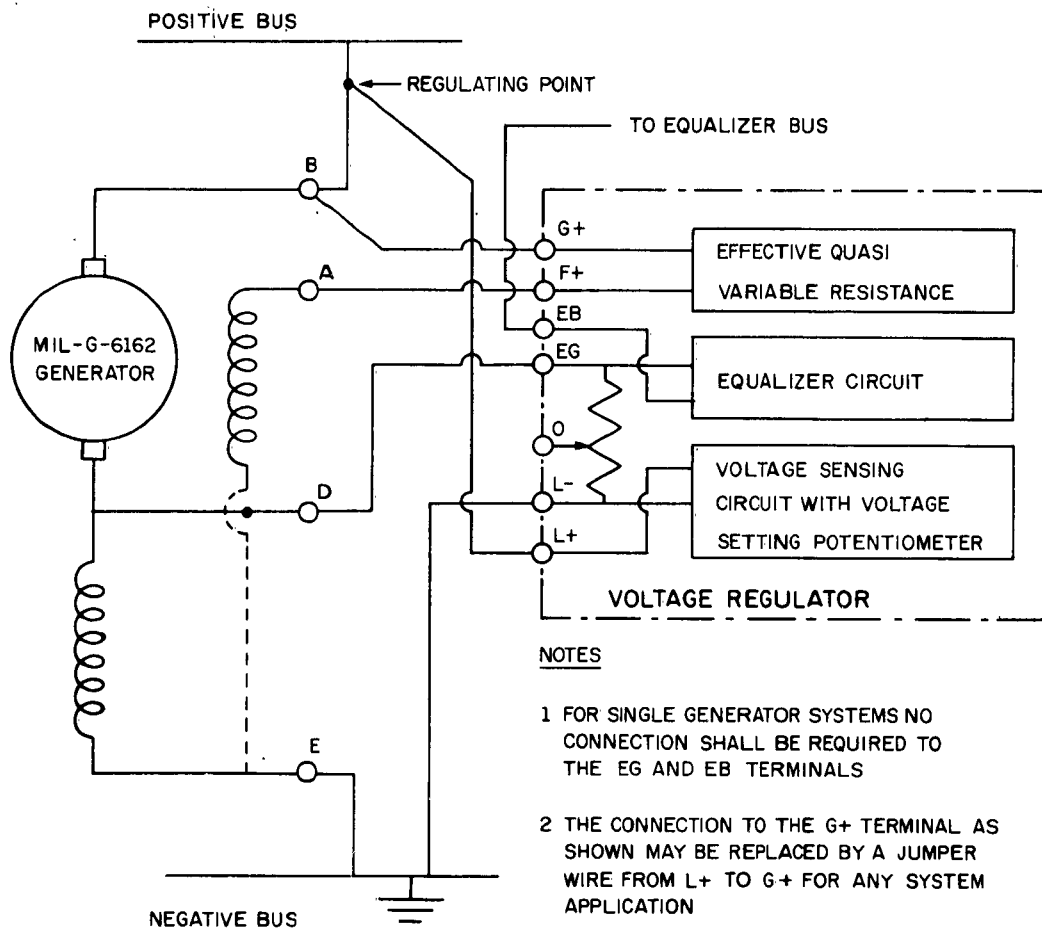


FIGURE 1 - Voltage Regulation Schematic Wiring Diagram

3.9 Safety Wiring and Staking - Accidental loosening of screws and screw parts and other connections shall be prevented by safety wiring (0.032-inch minimum outside diameter, where practical), staking, or other approved methods. Washers and cotter pins, where used, shall be assembled in a manner which prevents rotation of washers and movement of cotter pins under conditions of vibration.

3.10 Finish

3.10.1 Aluminum Alloy Parts - Wherever practical, aluminum alloy parts shall be anodically treated in accordance with Specification No. MIL-A-8625 or shall receive an approved chemical film in accordance with requirements of Specification No. MIL-C-5541. The films deposited by these treatments shall be removed from the actual contact area of all surfaces required to act as a path for electrical power and from the local areas under screws, nuts, or the like used for assembly or mounting purposes, to provide an adequate bonding connection.

3.10.2 Magnesium-Alloy Parts - Whenever practical, magnesium-alloy parts shall be surface treated in accordance with Specification No. MIL-M-3171 to provide protection against corrosion.

3.10.3 Plating - Cadmium plating shall be in accordance with Specification No. QQ-P-416.

3.11 Terminal Marking - Marking of terminals shall be as shown on the applicable MS drawing.

3.12 Identification of Product - Parts and subassemblies of voltage regulators requiring replacement during normal maintenance shall be marked with the manufacturer's part number and the manufacturer's name or trademark where practicable and shall be in accordance with Specification No. MIL-M-7911 as applicable.

3.12.1 Nameplate - All regulators shall be clearly marked with a metal nameplate securely attached to the regulator. The nameplate shall be clearly and legibly marked to give the following information. Abbreviations are permissible.

Regulator, Voltage, D-C Generator
Volts 30, Field Amperes 8
BUWEPS Part No.
Manufacturer's Part No. or Model No.
Manufacturer's Name or Trademark
Stock No.
Date of Manufacture
Acceptance Stamp

The nameplates shall also comply with additional requirements of Specification No. MIL-P-6906.

3.12.1.1 Part Number on Nameplate - The manufacturer's part number indicated on the nameplate shall be the number of the contractor's assembly drawing which includes subassembly ordering data. Any additional nameplates with proprietary data shall be attached to the regulator by means of readily removable screws.

3.12.1.2 Restriction on Size of Trademark - The manufacturer's name or trademark shall be in letters not larger than other letters appearing on the nameplate.

3.12.2 Use of AN or MIL Designations - AN or MIL designations shall not be applied to a product, except for qualification test samples, nor referred to in correspondence or sales matter, until notification has been received from the Aeronautical Standards Group that the product has been approved for aeronautical use, by both the Air Force and the Bureau of Naval Weapons.

3.13 Installation Instructions - For Navy purchases, the contractor shall pack with each regulator assembly one printed copy of simple instructions with illustrations and diagrams, if necessary, covering the installation of the regulator assembly. Prior to printing, two copies shall be furnished to the government for approval. Instructions shall be printed on 8-1/2- by 11-inch or 17- by 11-inch paper.

3.14 Workmanship - All machined surfaces shall have a smooth finish and all details of manufacture, including the preparation of parts and accessories, shall be in accordance with the best practice for

high quality electrical equipment. Particular attention shall be given to neatness and thoroughness of soldering, wiring, impregnation of coils, marking of parts, plating, lacquering, riveting, clearance between soldered connections, and ruggedness.

3.15 Performance - The voltage regulator shall satisfy the performance requirements specified in Section 4, when subjected to the applicable tests.

4. SAMPLING, INSPECTION, AND TEST PROCEDURES

4.1 Classification of Tests - The inspection and testing of voltage regulators shall be classified as follows:

- (1) Qualification Tests - Qualification tests are those tests accomplished on samples submitted for qualification as a satisfactory product.
- (2) Inspection Tests - Inspection tests are those tests accomplished on voltage regulators manufactured and submitted for acceptance under contract.

4.2 Qualification Tests

4.2.1 Sampling Instructions - Qualification test samples shall consist of four voltage regulators with reproducible copies of outline and assembly drawings upon which qualification is desired. Samples shall be forwarded to the agency designated in the Letter of Authorization from the qualifying service (see paragraph 6.1), plainly identified by securely attached durable tags marked with the following information:

Sample for Qualification Test
Regulator, Voltage, 30 Volt, Direct-Current Generator
BUWEPS Part No.
Manufacturer's Part No.
Date of Manufacture
Submitted by (name) (date) for qualification test in accordance with the requirements of
Specification MIL-R- under authorization (reference authorizing letter)

4.2.2 Tests - The qualification tests shall consist of the tests specified below, and shall be conducted in the order listed for each regulator. In addition, these tests may, at the option of the qualifying service, be supplemented with any other tests specified herein or with tests under actual service conditions, which the qualifying service considers necessary to determine conformance with the requirements of this specification. Equipment, failing to meet the requirements, does not qualify.

Regulator No. 1

Examination of Product
Voltage Regulation
Variable Resistance
Radio Interference
Vibration
Fungus
Salt Spray

Regulator No. 3

Examination of Product
Parallel Operation
Variable Resistance
Maximum Voltage Setting
Ripple Voltage
Endurance

Regulator No. 2

Examination of Product
Factors Affecting Voltage Regulation
Equalizer Circuit
Parallel Operation
Variable Resistance
Shock
Humidity

Regulator No. 4

Examination of Product
Variable Resistance
Time of Recovery
Heat Dissipation
Overload
Transient Voltage
Sand and Dust

4.2.2.1 Disassembly and Inspection - At the conclusion of the qualification tests, the voltage regulators shall be disassembled and inspected for defects.

4.3 Inspection Tests - The contractor shall furnish all samples and shall be responsible for accomplishing the tests specified herein. When inspection is conducted at the contractor's plant, all inspection and testing shall be subject to the approval of the government inspector. Contractors not having laboratory testing facilities satisfactory to the government shall engage the services of a commercial testing laboratory acceptable to the procuring service. The contractor shall furnish test reports, showing the results for all tests required by this specification, and signed by an authorized representative of the contractor or laboratory as applicable. Acceptance or approval of material during course of manufacture shall in no case be construed as a guaranty of the acceptance of the finished product.

4.3.1 Sampling - Each voltage regulator manufactured and submitted for acceptance under contract shall be subjected to the inspection tests specified herein.

4.3.2 Tests - The inspection tests of each voltage regulator shall consist of tests specified below, as described under "Test Methods."

Examination of Product
Voltage Regulation
Equalizer Circuit
Effective Resistance

In addition, the voltage regulator shall be subjected to any other tests specified herein which the government inspector considers necessary to determine conformance with the requirements of this specification.

4.3.3 Rejection and Retest - Regulators which have been rejected may be reworked or have parts replaced to correct the defects, and resubmitted for acceptance. Before resubmitting, full particulars concerning previous rejection and the action taken to correct the defects found in the original shall be furnished the government inspector. Units rejected after retest shall not be resubmitted without the specific approval of the procuring service.

4.4 Test Conditions - Unless otherwise specified, each test in this section shall be made under the following conditions:

4.4.1 Generator Used - The regulator shall control a generator in accordance with MIL-G-6162. The minimum and maximum speed for regulation shall be determined in accordance with the procedures of MIL-G-6162.

4.4.2 Position - The regulator shall control voltage within specified limits when operated in any position.

4.4.3 Auxiliary Equipment - No additional equipment, except that indicated by the manufacturer as necessary to meet the requirements of this specification and included in the weight and dimensions of the applicable MS drawing, shall be used.

4.4.4 Standard Test Conditions - Unless otherwise specified, all tests shall be conducted in still air at a barometric pressure of 29.92 ± 0.05 inches of mercury (approximating sea level altitude). The ambient temperature shall be maintained at $25^{\circ} \text{C} \pm 5^{\circ} \text{C}$.

4.4.5 Warmup - Prior to the test the regulator shall have operated for a period sufficient to stabilize the temperature of its various parts.

4.4.6 Voltage Setting - The regulated voltage shall be set at approximately 28 volts at 125 percent minimum speed for regulation at no load on the generator.

4.4.7 Voltage Measurement - The regulated voltage shall be measured between terminals "L+" and "L-."

4.5 Test Methods

4.5.1 Examination of Product - Each regulator, subassembly, and part shall be examined as the government inspector may deem necessary to determine conformance with this specification and the applicable drawings with respect to materials, voltage setting, adjustment, electrical connections, threaded parts, finish, interchangeability, marking, instructions, dimensions, weight, and workmanship.

4.5.2 Voltage Regulation - The regulated voltage shall be measured at room ambient under the following conditions:

- (1) (a) At minimum speed for regulation specified on the generator drawing, the load shall be varied from no load to full load. The load shall be suddenly removed and applied for each observation. (Shock loaded)
- (b) At average rated generator speed, the preceding test shall be repeated.
- (c) At maximum rated generator speed, the test of (1) (a) above shall be repeated.
- (d) At zero generator current, the speed shall be varied from 80 percent of minimum speed for regulation to maximum speed for regulation and returned. Do not shock load or bump regulator in any manner.
- (e) At 50 percent rated generator current, the speed shall be varied from 80 percent of minimum speed for regulation to maximum rated speed and returned. Do not shock load or bump regulator in any manner.
- (f) At 100 percent rated generator current, the preceding test shall be repeated.
- (2) Repeat (1) at -55° C.
- (3) Repeat (1) at 71° C or 120° C as applicable.

For each ambient temperature condition, the voltage shall remain within the limits specified on the applicable MS drawing over the generator speed and load range (minimum speed for regulation to maximum rated speed) except that to expedite testing the measured voltage can be above both limits by as much as 3 percent provided the overall variation does not exceed the difference between the fixed ambient limits specified on the applicable MS drawing.

4.5.3 Maximum Voltage Setting - The maximum voltage setting shall be obtained at full load conditions by setting the regulator to the maximum stop position at minimum rated speed. The point of regulation shall be located a minimum of 1 volt line drop from the generator at full load. The voltage shall be measured at the point of regulation. The regulator shall be capable of controlling the regulated voltage at 30 volts under these conditions.

4.5.4 Equalizer Circuit - The resistance and the effect of the equalizer circuit shall be determined when the regulator is controlling a generator in accordance with MIL-G-6162. The regulator shall be provided with an equalizer circuit for obtaining equal division of the load carried by two or more generators operating in parallel. This circuit shall lower the controlled voltage by 2.5 ± 0.25 volts when 0.25 of a volt is applied between terminal "E_b" and terminal "0," with terminal "0" negative to terminal "E_b." This test shall be performed at full load and no load conditions, at minimum speed for regulation. The resistance of the equalizer circuit shall be 0.4 ± 0.04 ohm at 25° C.

4.5.5 Parallel Operation - The regulators shall regulate the voltage when two generators are controlled by the regulators during parallel operation. The generators should conform to MIL-G-6162. The voltage regulation shall be within the limits of the applicable MS drawing when the regulator-generator system is operated at minimum and maximum generator speed at rated load. Load division shall be within 10 percent of the rating of one machine from 25 percent to full system load. Instability of the output voltage, failure to meet the load division requirement, or failure to meet the voltage regulation requirements of paragraph 4.5.2 will be cause for rejection of the regulator.

4.5.6 Variable Resistance

- (1) A generator conforming to MIL-G-6162 shall be operated with a fixed 1.25-ohm resistor placed in the field circuit in the exact location where the G+ and F+ terminals of the regulator would be located. The generator shall be operated at full rated load and at a speed sufficient to produce an output voltage of at least 26.5 volts. The output voltage, current, and generator speed shall be recorded.
- (2) The generator shall be operated with a fixed 35-ohm resistor replacing the 1.25 ohm resistor in the field circuit as described above. The generator shall be operated at its maximum speed for regulation with sufficient load to limit the output voltage to a maximum of 29.5 volts. The output voltage, current, and generator speed shall be recorded.

All voltage measurements shall be made at the point designated as the point of regulation for the system.

4.5.6.1 Low Value - This test shall be made immediately following satisfactory completion of the voltage regulation test at room ambient and with the generator system used for paragraph 4.5.6 (1).

- (1) The regulator shall control a generator at its specified minimum speed for regulation and full rated load for a period of time sufficient for the regulator components to reach a stable operating temperature.
- (2) With the generator-regulator system operated at full rated load and at the speed recorded for paragraph 4.5.6 (1), the maximum setting of the voltage adjusting potentiometer shall produce a regulated output voltage at least 0.5 volt greater than the voltage recorded in paragraph 4.5.6 (1). The load shall be switched off and on several times before the readings are taken.

4.5.6.2 High Value - This test shall be performed immediately following the variable resistance-low value test. The generator speed should be adjusted to the specified maximum speed for regulation. With the load current recorded in paragraph 4.5.6 (2) applied, the minimum voltage setting of the voltage adjusting potentiometer shall produce a regulated output voltage at least 0.5 volt less than the voltage recorded in paragraph 4.5.6 (2).

4.5.7 Time of Recovery - The voltage regulator shall be tested with any generator conforming to MIL-G-6162 with the generator operated at minimum, maximum and average speeds. A recording oscillograph shall be used to measure the voltage transient when full rated load is applied and removed. The voltage controlled by the voltage regulator during load changes between full and no load shall recover to and remain within 10 percent of its steady state condition within 0.05 second. The regulator shall not develop sustained oscillations under any of these load changes.

4.5.8 Heat Dissipation - The voltage regulator shall be operated to control the voltage of a generator which conforms to MIL-G-6162. The generator shall be operated at full rated load and a speed which will require the regulator to supply its full rated field current (8 amperes). Excess cooling air shall be provided to the generator to prevent damage during this test. The voltage regulator only shall be operated in a maximum ambient temperature of 71° C or 120° C as applicable. There shall be no forced ventilation of the regulator or the area immediately surrounding the regulator. The voltage regulator shall be capable of meeting the requirements of the voltage regulation test at room ambient, paragraph 4.5.2 (1), without readjustment after being subjected to the heat dissipation test for a period of 8 hours. The temperature shall be allowed to stabilize before voltage readings are taken.

4.5.9 Ripple Voltage - Ripple voltage shall be determined by means of a peak reading vacuum tube voltmeter in series with a 4.0-microfarad capacitor connected as shown in figure 2. The generator shall be operated at minimum, maximum, and average rated speeds at zero load, one-half load, and full load, and without a battery in parallel. Peak voltage readings shall be taken with the voltmeter successively connected for each of two polarities. The higher of the two readings shall not exceed the higher of the equivalent two readings, taken when a manually operated field rheostat is substituted for the voltage regulator, by more than 0.6 volt.

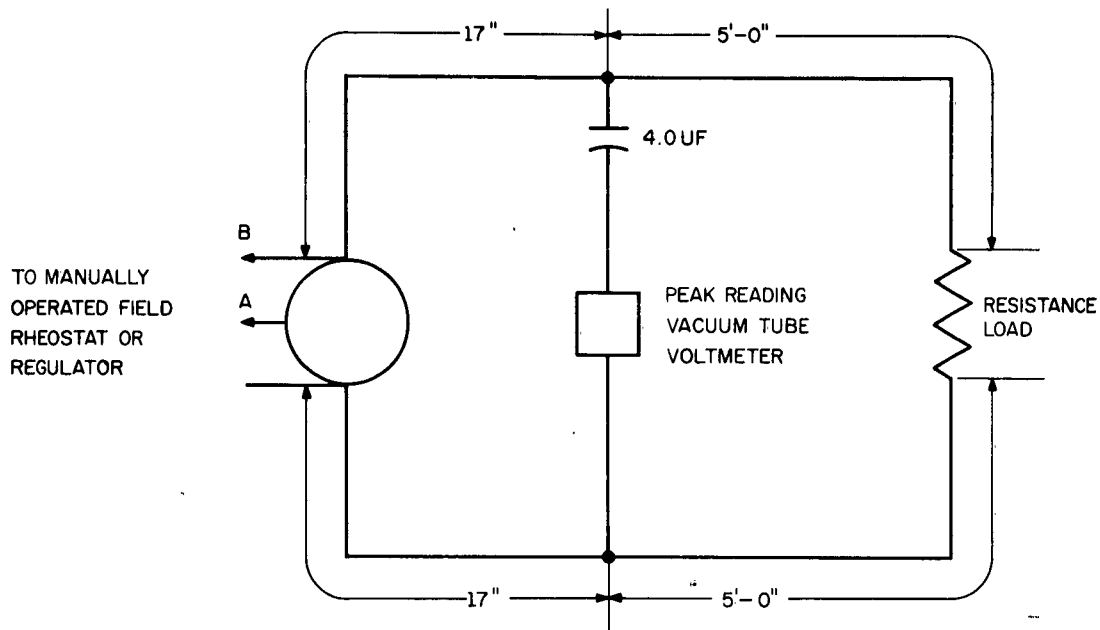


FIGURE 2 - Ripple Voltage Test Setup

4.5.10 **Factors Affecting Voltage Regulation** - Prior to each test in subparagraphs (1) through (4) below, the regulated voltage shall be adjusted as described in paragraph 4.4.6.

- (1) **Position** - The regulator shall be rotated by increments of no more than 90 degrees from the normal horizontal position, 360 degrees about each major axis except the vertical axis. If any of the operating positions are found to affect heating or voltage regulation the worst position shall be used for the remaining sections of this test.
- (2) **Warmup** - The regulator shall be soaked for at least 5 hours in an ambient temperature of -55°C (not operating and with no circuits energized) following which the regulator shall be connected to immediately control a generator operating at the average speed for regulation and full load. Readings of regulated voltage shall be recorded immediately and every two minutes until the voltage stabilizes. The regulated voltage shall remain within the regulation limits for all conditions specified on the detail drawing.
- (3) **Temperature** - The ambient temperature shall be decreased from 25°C to -55°C and then increased to 71°C or 120°C as applicable. Each temperature shall be held until the regulated voltage stabilizes as indicated by the readings taken at 10-minute intervals. Tests will be made at any other ambient temperature between the limits specified, at the option of the qualifying service. The regulated voltage shall remain within the regulation limits for all conditions specified on the applicable drawing.
- (4) **Altitude** - The pressure altitude shall be varied from approximately sea level to 50,000 feet. Tests will be made at intermediate altitudes at the option of the qualifying service. Each altitude shall be held until the regulated voltage stabilizes. Temperature shall be within 5°C of the pressurized curve of figure 3 at altitudes above 10,000 feet. The regulated voltage shall remain within the regulation limits for all temperature-altitude conditions specified on the detail drawing.

4.5.11 Radio Interference

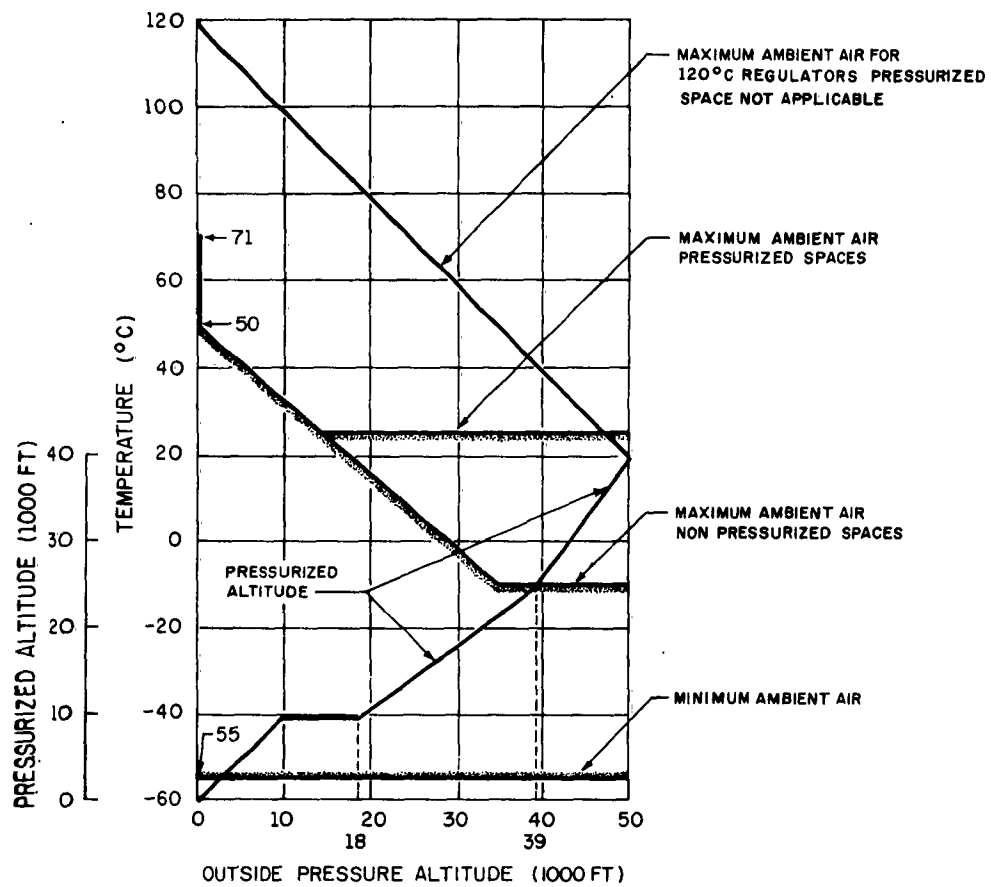


FIGURE 3 - Temperature and Altitude Range of Operation

4.5.11.1 Conducted Interference - Conducted interference shall be measured when the regulator is controlling a generator in accordance with MIL-G-6162 at maximum speed at both full load and no load conditions. The interference measurements shall be made between each regulator terminal and ground. The L-terminal shall be grounded to the ground plane. Conducted interference measurements shall be made between 0.15 and 20 megacycles in accordance with MIL-I-6181 requirements. The radio interference shall not exceed the limits specified in MIL-I-6181 for broadband conducted interference.

4.5.11.2 Radiated Interference - Radiated interference shall be measured in accordance with MIL-I-6181. The regulator shall control a generator in accordance with MIL-G-6162 at maximum rated speed and minimum speed for regulation at both full load and no load. Measurements shall be made between 0.15 and 400 megacycles. The radio interference shall not exceed the limits specified in MIL-I-6181 for broadband radiated interference.

4.5.12 Transient Voltage Test - A generator conforming to MIL-G-6162 shall be operated with its field controlled by a potentiometer. The L+, L-, and G+ terminals of the voltage regulator under test shall be connected to this source generator. The F+ lead from the test regulator and a ground lead from the source generator shall be connected to a second MIL-G-6162 generator, nonoperating, which will be used as a load for the regulator output. The terminal voltage of the source generator shall be adjusted to produce an eight-ampere current in the field of the load generator. From this initial condition resistance shall be switched out of the field circuit of the source generator to produce the following voltage transient schedule. Transient voltages shall be applied at a repetition rate not greater than one per minute.

Number of Applications of Transient Voltage	Amplitude (V DC)	Duration
50	60	0.02 sec
20	40	0.05 sec
1	32	10 min

This requirement is a measure of the DC voltage transient conditions required by MIL-STD-704.

4.5.13 Overload Current - The voltage regulator shall be operated in the same test circuit as was used for the transient voltage test of paragraph 4.5.12. The voltage of the source generator shall be reduced to produce a current in the field of the load generator equal to the overload current specified in the applicable detail specification or drawing. The voltage regulator shall deliver the required overload current for one hour after which it shall be inspected for damage and shall be required to pass the voltage regulation test of paragraph 4.5.2 (1).

4.5.14 Endurance - The regulator shall be connected to control a generator in accordance with MIL-G-6162. The generator shall be operated for 200 hours at a speed which will require the greatest variation in the variable resistance of the regulator when full rated generator current is switched on and off. The load shall be switched on for 5 seconds and off for 5 seconds. Sufficient readings shall be taken to determine compliance with the requirements of this test. Following this test the regulator shall meet the voltage regulation test, at room ambient temperature paragraph 4.5.2 (1), and the time of recovery test, paragraph 4.5.7. The voltage regulator shall be capable of operation without permitting the regulated voltage to drift more than 0.3 volt during any 25 hour period or 0.8 volt during the entire test. Failure to meet the time of recovery test at any time during this test shall be cause for rejection.

4.5.15 Vibration - The regulator shall be subjected to the vibration test specified in Procedure XII and figure 1, curve A of MIL-E-5272. The regulator shall control a generator at average speed at no load during the test. The regulator shall pass the first three parts of the voltage regulation test, paragraph 4.5.2 (1) (a), (b) and (c). Damage or failure of any part of the regulator during this test shall be cause for rejection.

4.5.16 Shock - The regulator shall be subjected to the shock test of Procedure V of MIL-E-5272. Damage or failure shall be cause for rejection. Following this test the regulator shall pass the first three parts of the voltage regulation test, paragraph 4.5.2 (1) (a), (b) and (c).

4.5.17 Humidity - The humidity test shall be performed in accordance with Procedure I of MIL-E-5272. Deterioration or corrosion of any internal or external parts which could in any manner prevent the voltage regulation from meeting operational requirements during service life shall be cause for failure. The requirements for voltage regulation, paragraph 4.5.2 (1), shall be met at the end of the humidity test.

4.5.18 Salt Spray Test - The regulator shall be subjected to a salt spray test in accordance with Procedure I of MIL-E-5272. Upon completion of this test any salt deposits shall be brushed from the regulator. The regulator shall be permitted to air dry for 48 hours at 25° C after which the regulator will be required to pass the voltage regulation test, paragraph 4.5.2 (1). Damage or failure of the regulator during this test shall be cause for rejection.

4.5.19 Sand Resistance - The voltage regulator shall be subjected to the sand and dust test in accordance with Procedure I of MIL-E-5272. The equipment shall not be operated during this test. Upon completion of the test the voltage regulator shall meet the requirements of the voltage regulation test, paragraph 4.5.2 (1).

4.5.20 Fungus Resistance Test - The voltage regulator shall be subjected to the fungus resistance test in accordance with Procedure I of MIL-E-5272. Following the test the regulator shall be inspected for general deterioration and shall meet the voltage regulation test, paragraph 4.5.2 (1).

5. PREPARATION FOR DELIVERY

5.1 Application - The packaging, packing, and marking requirements specified herein apply only to direct purchases by or direct shipments to the government.

5.2 Preservation and Packaging

5.2.1 Level A - The regulator shall be packaged in accordance with MIL-P-7936. Preservation shall be in accordance with MIL-P-116, Method II, without preservation compound. One regulator shall be packed per container.

5.2.2 Level C - The regulator shall be preserved and packaged individually in accordance with the manufacturer's commercial practice.

5.3 Packing

5.3.1 Level A - Unless otherwise specified, regulators shall be packed in accordance with MIL-P-7936. Shipping containers shall be exterior export type conforming to tables II, III, or IV of MIL-P-7936.

5.3.2 Level B - Unless otherwise specified, regulators shall be packed in accordance with MIL-P-7936. Shipping container shall be exterior domestic type conforming to tables II, III, or IV of MIL-P-7936.

5.3.3 Level C - Shipping containers shall meet the requirements of MIL-P-7936 for Level C packing.

5.4 Marking and Labeling - Each package and shipping container shall be durably and legibly marked in accordance with the requirements of MIL-STD-129.

5.5 Acceptance Stamp - Each package and shipping container shall be durably and legibly marked in accordance with the requirements of MIL-STD-129. In addition, two opposite sides of each shipping container or exterior packing shall be marked with the government acceptance stamp.

6. NOTES

6.1 Provision for Qualification Tests - The right is reserved to reject any bids on regulators covered by this specification which have not been subjected to the required qualification tests and found satisfactory for inclusion on a Qualified Products List. The attention of suppliers is called to this requirement. Request for authorization for qualification tests of the proposed regulators shall be made to the Bureau of Naval Weapons, Navy Department, Washington 25, D. C. or the activity responsible for the qualification.

6.2 Miscellaneous Notes

6.2.1 The dielectric strength test for capacitors described in section 3 is not a test of ultimate dielectric strength and is not presented as a design criterion. The purpose of this test is to assure the satisfactory performance of individual capacitors under operating conditions. Capacitors used shall be suitable for the purpose and shall conform to applicable government specifications.

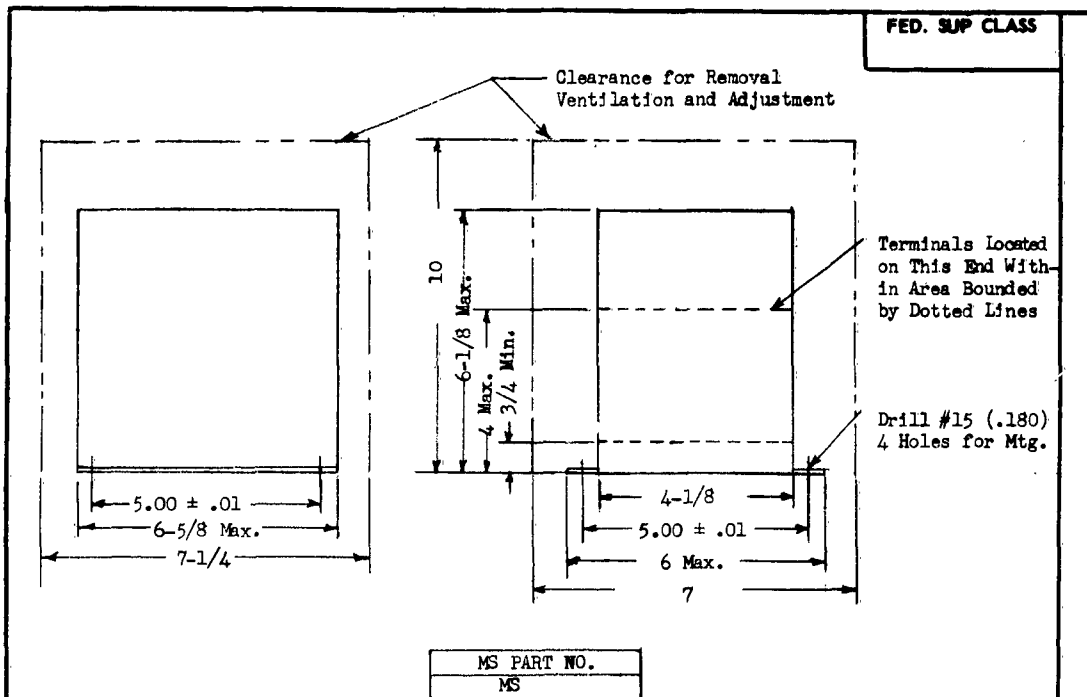
6.3 Precedence - When the requirements of the contract, this specification, or applicable subsidiary specification or applicable equipment drawings are in conflict, the following precedence shall apply:

- (1) Contract - The contract shall have precedence over any specification or drawing.
- (2) Military Standards and E Drawings - Applicable MS or E equipment drawings shall govern when the applicable drawings are in conflict with this specification.
- (3) This Specification - This specification shall have precedence over all subsidiary specifications.
- (4) Referenced Specifications - Any referenced specification shall have precedence over all applicable subsidiary specifications referenced therein. All referenced specifications shall apply to the extent specified.

NOTICE - When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished or in any way supplied the said drawings, specifications or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use or sell any patented invention that may in any way be related thereto.

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This standard has been approved by the Department of the Army and is mandatory for use by that activity. All other military activities are required to employ this standard where suitable.



CHARACTERISTICS OF VOLTAGE REGULATOR

Continuous Field Current Min Amps	8
Overload Field Current Min Amps	12
Variable Quasi Resistance High Value Min Ohms	35
Variable Quasi Resistance Low Value Max Ohms	1.25
Weight Max Pounds	4.63
Regulating Tolerance Limits Fixed Amb Volts	$\pm .8$
Regulating Limits - All Conditions Volts	26.5-29.5
Maximum Ambient Temperature	71° C

NOTES

1. Dimensions in inches unless otherwise specified - Tolerances: Decimals $\pm .005$; Fractions $\pm 1/64$.
2. Two tip jacks shall be provided on the regulator to accommodate $.078 \pm .002$ inch diameter male tips. The tip jacks shall be suitably wired to indicate the regulated voltage. The positive jack shall be red, the negative jack shall be black. The jacks shall be easily accessible from the top of the unit with a minimum of $1/2$ inch between centers.
3. Voltage adjust and parallel adjust potentiometers shall be located so as to be adjustable from the top of the regulator with a straight screw driver. The potentiometers shall be suitably labeled.
4. The aircraft manufacturer shall allow sufficient clearance for the maximum dimensions shown on this drawing for installation and removal of the regulator.
5. Clearance shall be provided for access to voltage and parallel adjustment means. Clearance shall be provided for electrical connections and slack shall be provided in the leads to the terminals.

P.A.	TITLE	MILITARY STANDARD
Other Cust	REGULATOR-VOLTAGE 71° CENTIGRADE CLASS DIRECT CURRENT GENERATOR, 28 VOLTS	MS
Procurement Specification MIL-R-6809	SUPERSEDES: EL597	SHEET 1 OF 2

DD FORM 672 (Limited coordination) PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE.

NOTES TO PRINTER: REDUCE BORDER TO 6-27/32x9-3/4. PRINT LEFT BORDER LINE ONE INCH FROM LEFT EDGE OF 8x10-1/2 SHEET. PRINT BOTTOM BORDER LINE 3/8 INCH FROM BOTTOM EDGE OF 8x10-1/2 SHEET. SIGNATURE FORM NOT TO BE INCLUDED ON 8x10-1/2 SHEET.

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NOTICE.—When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility, nor any obligation whatsoever; and the fact that the Government may have furnished, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

This standard has been approved by the Department of the Army and is mandatory for use by that activity. All other military activities are required to employ this standard when suitable.

FED. SUP CLASS

6. The adjustable equalizer potentiometer shall be connected across the terminals EG and L- with the slider connected to the O terminal. This potentiometer shall have a value of $2.0 \pm .2$ ohms with a dissipating capacity of at least 10 watts. With the generators operating in parallel, clockwise rotation of the potentiometer increases the load on the generator being controlled by this regulator.

7. Vibration absorbing devices shall not be used on this regulator.

TERMINALS

8. Seven terminals shall be provided, positioned in this order, from left to right, looking at the terminal board end: EB, L+, F+, EG, G+, O, L-.

9. Terminals shall consist of the following screw AN520B10-16, washer AN960B10, nut AN315-3R, nut AN365B10-32, and washer AN935-10; 7 each required.

10. Insulating barriers shall be incorporated between terminals. Five-eighth inch diameter clearance around terminal for wrench clearance shall be provided.

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P.A.	TITLE	MILITARY STANDARD
Other Cust	REGULATOR-VOLTAGE 71° CENTIGRADE CLASS DIRECT CURRENT GENERATOR, 28 VOLTS	MS
Procurement Specification MIL-R-6809	SUPERSEDES: E1597	SHEET 2 OF 2

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<p>U. S. Naval Air Development Center, Johnsville, Pa. Aeronautical Electronic and Electrical Laboratory</p> <p>PROPOSED SPECIFICATION, REGULATOR, VOLTAGE, STATIC, 28-VOLT DIRECT CURRENT GENERATOR, GENERAL SPECIFICATION FOR: by A. Lavery; 14 Mar 1963; 16 p; Report No. NADC-EL-6305; Phase Report, WEPTASK No. RAES0J011/2021/F012-11-01, Problem No. J45AES2-14. Report: UNCLASSIFIED</p> <p>This specification covers static 28-volt direct current voltage regulators for use to control naval aircraft direct current generators.</p>	<p>I. Lavery, A.</p>
<p>U. S. Naval Air Development Center, Johnsville, Pa. Aeronautical Electronic and Electrical Laboratory</p> <p>PROPOSED SPECIFICATION, REGULATOR, VOLTAGE, STATIC, 28-VOLT DIRECT CURRENT GENERATOR, GENERAL SPECIFICATION FOR: by A. Lavery; 14 Mar 1963; 16 p; Report No. NADC-EL-6305; Phase Report, WEPTASK No. RAES0J011/2021/F012-11-01, Problem No. J45AES2-14. Report: UNCLASSIFIED</p> <p>This specification covers static 28-volt direct current voltage regulators for use to control naval aircraft direct current generators.</p>	<p>I. Lavery, A.</p>